A survey for threatened fauna in south-western New South Wales

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ABSTRACT

Surveys targeting 24 threatened fauna species were conducted in riparian (37 study sites) and mallee (3 study sites) vegetation communities in State Forests and other Crown timber lands in south-western New South Wales. The surveys were successful in locating eleven of the targeted threatened species and two non-target species. Five threatened species (four birds and one mammal) were recorded within the mallee study sites and seven from the riparian study sites (one amphibian, one reptile, three birds and two mammals). The surveys extended the known distribution of the Brush-tailed Phascogale *Phascogale tapoatafa* and Squirrel Glider *Petaurus norfolcensis* in New South Wales.

Introduction

South-western New South Wales contains a diverse range of fauna habitats, including riverine forests, box eucalypt and cypress pine woodlands, mallee, acacia and chenopod shrublands and native grasslands. While much of the original vegetation has been cleared for agriculture (WRRVC 1999, Eardley 1999), extensive areas of native vegetation persist on the River Murray floodplain (FCNSW 1987), in mallee communities west of Balranald (Mazzer *et al.* 1998) and as native grasslands on the Riverine Plain (Benson *et al.* 1997). There have been no systematic fauna surveys in this area apart from recent studies conducted in the Southern Mallee Region (Mazzer *et al.* 1998). With the exception of the Regent Parrot *Polytelis anthopeplus* and Superb Parrot *P. swainsonii*, there is a dearth of information on species considered to be endangered or vulnerable (hereafter referred to as threatened species) under the *Threatened Species Conservation Act 1995*.

This paper reports on the results of a survey for threatened fauna in State Forests and other Crown timber lands in south-western New South Wales. River Red Gum *Eucalyptus camaldulensis* and mallee communities in this region are considered to provide suitable habitat for 59 threatened fauna species (Ayers *et al.* 1996, Mazzer *et al.* 1998). Targeted surveys were restricted to the 24 species considered to occur within the geographic area of proposed State Forests of New South Wales (SFNSW) harvesting operations, for which additional distributional and habitat information was required. It was one of a number of surveys funded by SFNSW to provide information on the distribution of threatened fauna species in western New South Wales.

Surveys targeting the Black-eared Miner *Manorina melanotis* were not conducted as Franklin (1993) failed to locate any evidence that this species was still present in New South Wales. Surveys targeting the Regent Parrot and Superb Parrot were also not conducted as the distribution and habitat requirements of these species had previously been sufficiently documented (e.g. Beardsell 1985, Burbidge 1985, Webster 1988, Webster and Ahern 1992). Other threatened species present in south-western New South Wales were excluded from the survey as they were not considered to be sensitive to habitat disturbance associated with proposed harvesting operations. Those species are: Magpie Goose *Anseranas semipallmata*, Blue-billed Duck *Oxyura australis*, Freckled Duck *Stictonetta naevosa*, Australasian Bittern *Botaurus poicilopiilus*, Australian Bustard *Ardeotis australis*, Plains-wanderer *Pedionomus torquatus*, Black-tailed Godwit *Limosa limosa* and Painted Snipe *Rostratula benghalensis*.

Since 1995 a number of fauna species have been added to the schedules of the *Threatened Species Conservation Act 1995*. Those species that are found within the study area are: Glossy Black Cockatoo *Calyptorhynchus lathami* (Riverina population), Barking Owl *Ninox connivens*, Brown Treecreeper *Climacteris picumnus*, Black-chinned Honeyeater *Melithreptus gularis*, Hooded Robin *Melanodryas cucullata*, Grey-crowned Babbler *Pomatostomus temporalis* and Diamond Firetail *Stagonopleura guttata*. These species were not considered as part of this survey.

Methods

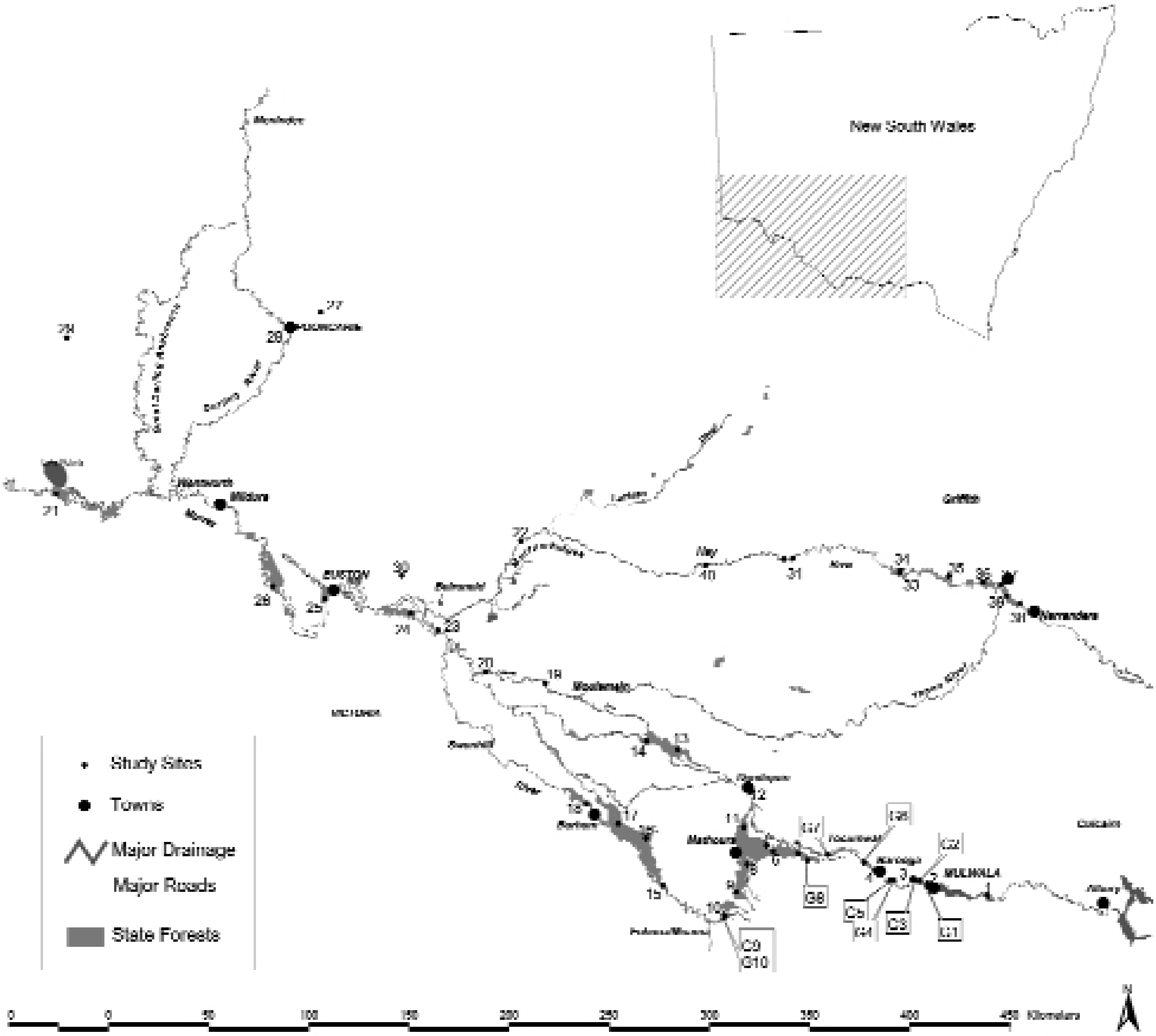
Study sites

The study sites were located along the Murrumbidgee River between Narrandera and Balranald, the Murray River between Corowa and the South Australian border and in blocks of mallee west of the Great Anabranch of the Darling River, east of Pooncarie and west of Balranald. Forty study sites were established in total; 37 in riparian habitats and 3 in mallee communities in State Forests and other Crown timber lands (Figure 1). Study sites situated on the floodplains of the Murray and Murrumbidgee Rivers were predominantly forested with River Red Gum. The mallee study sites contained dune mallee, swale mallee and irregular dune mallee vegetation communities (Fox 1991, Scott 1992, Porteners *et al.* 1997). Study site selection was determined by the location of SFNSW proposed harvesting operations for 1995–1999, but also included Flora Reserves and other areas not included in the harvesting schedule.

Three transects of 200 m were established to sample fauna along vegetation gradients at each study site, giving a total of 120 transects. Riparian study sites were sampled by placing transects in wet and dry ecotypes. The wet ecotype (Transect 1) usually contained tall open River Red Gum forest on frequently flooded sites close to the river bank, which commonly merged into an open woodland structure on the floodplain margins (Transect 3) supporting either River Red Gum or box eucalypt species (Black Box *E. largiflorens*, Yellow Box *E. melliodora* and/or Western Grey Box *E. microcarpa*). Transect 2 was in lower site quality drier open river red gum forest between transects 1 and 3. In the mallee study sites, transects were located to sample dune mallee and swale mallee.

Targeted fauna surveys were conducted along all transects containing suitable habitat for up to 24 threatened fauna species. To more comprehensively survey for threatened diurnal birds, traverses of 10 km were also established at each of the three mallee study sites. Ten glider plots of 200 m were also established in suitable habitat in State Forests between Corowa and Moama targeting Squirrel Gliders *Petaurus norfolcensis*.

Field surveys were undertaken from 10 October 1994 to 7 March 1995 during a period of drought. Although surveys targeted threatened species, all fauna observed or trapped on the study sites were also recorded. The survey methods adopted were determined by the guidelines prepared by NSW National Parks and Wildlife Service (NSW NPWS) and SFNSW (1994).


New South Wales
Study Sites
Towns
Major Drainage
Major Roads
State Forests
Wentworth
Mildura
Murray
Darling River
EUSTON
Balranald
Hay
Griffith
Narrandera
Moulamein
Deniliquin
Barham
Mathoura
Tocumwal
Barooga
MULWALA
Albury
VICTORIA
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
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16
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9
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6
5
4
3
2
1
G1
G2
G3
G4
G5
G6
G7
G8
G9
G10
0
0
50
100
150
200
250
300
350
400
450 Kilometers
N

Study sites (SF, State Forest. WLL, Western Lands Lease)						Glider plots	
1	Collendina SF	17	Koondrook SF	28	Pooncarie WLL	G1	Mulwala SF
2	Mulwala SF	18	Campbells Island SF	29	Scotia WLL (Mallee)	G2-3	Boomanoomana SF
3	Boomanoomana SF	19	Berambong SF	30	Abbott's Tank WLL (Mallee)	G4-5	Cottadidda SF
4	Barooga SF	20	Kyalite SF	31	Warradgery SF	G6	Barooga SF
5-7	Millewa SF	21	Lake Victoria SF	32	Toms Point SF	G7	Native Dog SF
8-9	Moira SF	22	Redbank Weir WLL	33	Yarrada SF	G8	Millewa SF
10	Bama SF	23	Balranald WLL	34	Benerembah SF	G9-10	Bama SF
11	Gulpa Island SF	24	Maine SF	35	Cuba SF		
12	Deniliquin SF	25	Euston SF	36-7	MIA 2		
13-14	Werai SF	26	Gol Gol SF	38-9	MIA 1		
15-16	Perricoota SF	27	Pooncarie WLL (Mallee)	40	Woolondool SF		

Figure 1 Location of study sites and glider plots

Survey methods

Targeted surveys for the following 24 threatened species were undertaken for a total of 129 person days as described below.

Amphibians

i) *Litoria raniformis*. Transects close to rivers and wetlands were surveyed by auditory and call playback methods on two different nights.

Reptiles

i) Mallee Worm Lizard *Aprasia inaurita*, Striped Legless Lizard *Delma impar*, Bardick *Echiopsis curta* and Western Blue-tongued Lizard *Tiliqua occipitalis*. Searches were made by raking through litter, lifting loose bark and inspecting woody debris in areas of suitable habitat along the mallee transects. Ten dry pitfall traps connected by drift fences were also established along the mallee transects and checked daily for 10 consecutive days.

Birds

i) Malleefowl *Leipoa ocellata*. Visual searches for individuals and nesting mounds were conducted along the mallee transects and traverses, including a playback of territorial calls at regular intervals (approximately every 500 m) followed by a quiet listening period of 10 minutes along the traverses.

ii) Bush Stone-curlew *Burhinus magnirostris*. Nocturnal auditory searches and playback of calls were conducted in transects located in or near box eucalypt woodland followed by a quiet listening period of 10 minutes.

iii) Square-tailed Kite *Lophoictinia isura*. Visual and auditory searches were conducted along all transects located in suitable habitat.

iv) Masked Owl *Tyto novaehollandiae*. All riparian transects were surveyed for this species, involving an initial 10 minute listening period followed by spotlighting by two observers and a 5minute playback of Masked Owl calls, on two different nights.

v) Major Mitchell's Cockatoo *Cacatua leadbeateri*, Striated Grasswren *Amytornis striatus*, Shy Heathwren *Hylacola cauta*, Purple-gaped Honeyeater *Lichenostomus cratitus*, Southern Scrub-Robin *Drymodes brunneopygia*, Chestnut Quail-thrush *Cinclosoma castanotus*, Red-lored Whistler *Pachycephala rufogularis* and Gilbert's Whistler *Pachycephala inornata*. Visual and auditory searches were conducted for these species along the mallee transects and traverses, including a playback of territorial calls at regular intervals (approximately every 500 m) followed by a quiet listening period of 10 minutes.

vi) Painted Honeyeater *Grantiella picta*. Searches were concentrated within areas of River Red Gum and Box woodland containing fruiting mistletoes *Amyema* spp. Call playbacks of this species were also used along the mallee traverses.

Arboreal marsupials

i) Squirrel Glider and Koala *Phascolarctos cinereus*. Riparian study sites east of Euston were surveyed for these species. Each transect was spotlighted by two observers on two different nights. Five hair tubes baited with a peanut butter/oat mix were also placed in trees for ten days.

Eight 200 m glider plots were established in River Red Gum with a dense Silver Wattle *Acacia dealbata* understorey between Mulwala State Forest and Millewa State Forest. Two further glider plots were also established in Bama State Forest where Squirrel Gliders have been observed gliding across the Murray River (P. Menkhorst DNRE pers comm). Up to 10 cage traps and Class B Elliott traps (15x15x46cm) baited with a peanut butter/oat mix were placed in trees for a period of up to five nights. Glider plots were also spotlighted by two observers on two different nights. Survey effort was discontinued once the target species was captured or sighted during nocturnal searches.

ii) Brush-tailed Phascogale *Phascogale tapoatafa*: Fifteen hair tubes (10 on the ground and five in trees) alternatively baited with meat and a peanut butter/oats mix were established along all riparian transects east of Euston and left in place for ten days. Twenty-five Class A Elliott traps (9x10x33 cm) baited with a peanut butter/oats mix were also placed on the ground for four nights. Predator scats were collected and analysed for these species.

Ground-dwelling mammals

i) Kultarr *Antechinomys laniger* and Southern Ningaui *Ningaui yvonneae*. Ten hair tubes and 25 Class A Elliott traps baited with a peanut butter/oats mix were placed on the ground along the mallee transects for ten days and four nights respectively. Ten pitfall traps connected by drift fences were also established along the mallee transects and checked daily for 10 consecutive days. Predator scats were collected and analysed for these species.

ii) Spotted-tailed Quoll *Dasyurus maculatus*. Fifteen hair tubes (10 on the ground and 5 in trees) alternatively baited with meat and a peanut butter/oats mix were established along all riparian transects east of Euston and left in place for ten days. Predator scats were collected and analysed for these species.

Table 1. Threatened species records by State Forest and other Crown timber lands in south-western New South Wales. See footnotes for source of records and location details.

Common Name	Scientific Name	Location																																						Total	All
		1	2	3	4	5-7	8-9	10	11	12	13-4	15-6	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36-7	38-9	40	G1	G2-3	G4-5	G6	G7	G8	G9-10	Sites[1]	Sources
Growling Grass Frog	*Litoria raniformis*			a													X	X			X																					3	3
Western Blue-tongued Lizard	*Tiliqua occipitalis*																			X					bf																	1	2
Malleefowl	*Leipoa ocellata*																								Xbf	Xf																2	2
Square-tailed Kite	*Lophoictinia isura*						m		m																																	0	2
Bush Stone-curlew	*Burhinus grallarius*						m				m					X																										1	3
Major Mitchell's Cockatoo	*Cacatua leadbeateri*																						Xf		Xbf	Xf																3	3
Superb Parrot	*Polytelis swainsonii*					w			w																				Xw	Xw	Xw	w	Xw									4	8
Regent Parrot	*Polytelis anthopeplus*																			X	X																					2	2
Striated Grasswren	*Amytornis striatus*																								bfm																	0	1
Shy Heathwren	*Sericornis cautus*																								fm																	0	1
Regent Honeyeater	*Xanthomyza phrygia*					m																																				0	1
Painted Honeyeater	*Grantiella picta*					m	m		m																																	0	3
Southern Scrub-robin	*Drymodes brunneopygia*																								fm																	0	1
Chestnut Quail-thrush	*Cinclosoma castanotus*																						Xf		Xbf	Xf																3	3
Gilbert's Whistler	*Pachycephala inornata*					m		m	m			m								A					f	Xf																1	7
Brush-tailed Phascogale	*Phascogale tapoatafa*	X									X																															2	2
Southern Ningaui	*Ningaui yvonneae*																								Xb																	1	1
Koala	*Phascolarctos cinereus*					m																																	Xm			1	2
Squirrel Glider	*Petaurus norfolcensis*		X	X	X																														X	X	X	X			M	7	8

Results

A total of 189 native species (7 amphibian, 32 reptile, 136 birds and 14 mammal species) and 13 introduced species (2 bird and 11 mammal) were recorded, including 13 threatened species (Table 1). Appendix 1 contains records of all fauna species recorded for each State Forest and Western Lands Lease surveyed.

Frogs

Only one threatened frog species (*Litoria raniformis*) was recorded during the survey. The playback procedure elicited one response in a permanent lagoon vegetated with grasses (Poaceae) and sedges (Cyperaceae) in Euston State Forest. Opportunistic records of *Litoria raniformis* were also made at Lake Victoria State Forest and Redbank Weir (G. Hoye pers. comm.). All records were of single individuals.

Reptiles

The only threatened reptile recorded during the course of the surveys was a single Western Blue-tongued Lizard. This was an opportunistic sighting made within Manie State Forest. The individual was located on the edge of the floodplain within a Nitre Goosefoot *Chenopodium nitrariaceum*/Lignum *Muehlenbeckia florulenta* shrubland.

Birds

Targeted surveys conducted in the mallee study sites located four species of threatened birds (Malleefowl, Major Mitchell's Cockatoo, Chestnut Quail-thrush and Gilbert's Whistler).

Two Malleefowl responded to call playbacks during the traverse in the Scotia mallee. The Malleefowl were utilising arid shrubland consisting of a mosaic of species (Red Mallee *Eucalytpus socialis*, White Mallee *E. dumosa,* Belah *Casuarina pauper* and Western Rosewood *Alectryon oleifolius*) or Belah and Western Rosewood. In the Abbots Tank mallee, a single Malleefowl was observed twice (opportunistically), and five Malleefowl mounds (two active, two inactive and one of uncertain status) were observed during the traverse. The individual bird and mounds were found in dune–crest mallee/swale mallee. These vegetation communities were dominated by White Mallee, Red Mallee, Glossy-leaved Red Mallee *E. oleosa*, Snap and Rattle *E. gracilis* and Porcupine Grass *Triodia scariosa*.

Thirty-three records of Major Mitchell's Cockatoos were made, the majority (23) were opportunistic sightings. The remainder were made during mallee traverses (Scotia mallee 5 and Pooncarie mallee 5). Major Mitchell's Cockatoos were found in a variety of habitats, including arid shrubland, bluebush *Marieana sedifolia* shrubland, dune mallee, dune-crest mallee/swale mallee and irregular dune mallee. The dominant species in irregular dune mallee were Red Mallee and Porcupine Grass.

Chestnut Quail-thrush were recorded at the three mallee study sites (Scotia mallee 3 records, Pooncarie mallee 6 records and Abbots Tank mallee 9 records). Two records were collected opportunistically, the remainder were gathered using call playbacks during the mallee traverses. Chestnut Quail-thrush were found in arid shrubland in the Scotia mallee, irregular dune mallee within the Pooncarie mallee and dune-crest mallee/swale mallee in the Abbots Tank mallee.

Gilbert's Whistlers were only recorded from the Abbots Tank mallee. Nine records were obtained during the mallee traverse and one record opportunistically. All records were from the dune-crest mallee/swale mallee community.

No observations of Striated Grasswren, Shy Heathwren, Purple-gaped Honeyeater, Painted Honeyeater, Southern Scrub-Robin and Red-lored Whistler were made at the mallee study sites.

Targeted surveys conducted in River Red Gum and box woodland for Bush Stone-curlew, Square-tailed Kite, Masked Owl and Painted Honyeater did not locate any of these threatened species. However, one record of a Stone-curlew and two other threatened bird species were recorded opportunistically. A pair of Bush Stone-curlews were located in mixed species eucalypt woodland in Kyalite State Forest. Regent Parrots were recorded in Euston State Forest (2 records of between 2-15 birds), Maine State Forest (4 records of between 7-18 birds) and on the Sturt Highway west of Balranald (a single opportunistic record of two birds). Regent Parrots were observed nesting in River Red Gums in both State Forest locations. Superb Parrots were recorded from Benerembah State Forest (2 records single individuals), Yarrada State Forest (2 records single individuals) and Cuba State Forest (2 records of between 2-16 birds).

No Black-eared Miners were located during the mallee component of this study, although some individuals in a group of Yellow-throated Miners M. *flavigula* in the Scotia Mallee showed characteristics of hybrids (i.e. Black-eared x Yellow-throated Miner).

Arboreal Marsupials

Squirrel Gliders were trapped on four of the ten glider plots (G1, 2, 5 and 6) with a total of 5 captures in Mulwala, Boomanoomana, Cottadidda and Barooga State Forests. Squirrel Gliders were also seen by spotlight in the glider plot in Mulwala State Forest (G1), and on one River Red Gum transect in Mulwala State Forest on two occasions. This transect contained River Red Gum and Yellow Box woodland, but no stands of Silver Wattle. Three Squirrel Glider skins were also recovered. One each from barbed wire fences within Moama and Benarca State Forests and the third from a hollow tree trunk in Cottadidda State Forest.

Koalas were recorded opportunistically in Native Dog State Forest adjacent to a glider plot (G7).

Brush-tailed Phascogales were recorded from Collendina (tree-mounted hair tube in a Western Grey Box woodland) and Werai State Forests (jawbone recovered from an owl pellet adjacent to a Black Box woodland). Trapping and spotlighting failed to record any Brush-tailed Phascogales during the survey.

Ground-dwelling Mammals

Three Southern Ningauis were captured in pitfall traps on two transects within the Scotia mallee, in open mallee woodland with relatively dense stands of Porcupine Grass. Southern Ningauis were not detected at the other mallee study sites where Porcupine Grass was either absent or sparse.

Kultarrs and Spotted-tailed quolls were not recorded during the survey.

Discussion

Eleven of the 24 targeted threatened fauna species (Growling Grass Frog, Western Blue-tongued Lizard, Malleefowl, Bush Stone-curlew, Major Mitchell's Cockatoo, Chestnut Quail-thrush, Gilberts Whistler, Brush-tailed Phascogale, Southern Ningaui, Koala and Squirrel Glider) were detected, together with two non-target species (Regent Parrot and Superb Parrot). Five threatened species (four birds and one mammal) were recorded within the mallee study sites and seven from the River Red Gum study sites (one amphibian, one reptile, three birds and two mammals). Fewer threatened fauna species were detected than anticipated. Drought conditions during the survey period may have been a contributing factor, together with inadequate sampling of mallee communities with a dense shrub understorey.

Litoria raniformis was recorded from only three sites. This species was considered to be abundant in south-western New South Wales 30-40 years ago (Sadlier 1994). Since then, its distribution has contracted eastward and it is now considered to be common only to the west of Mildura in the vicinity of Lake Victoria (P. Robinson pers. comm.) and on the Murrumbidgee River between Balranald and Hay (Ayers *et al.* 1996). These conclusions are supported by this study. *Litoria raniformis* is also now commonly recorded within the Coleambally Irrigation District (RW pers. obs., M. Mullins pers. comm.).

Only one individual Western Blue-tongued Lizard was observed. Although this record is within the area expected to contain suitable habitat (Ayers *et al.* 1996) it is well east of recent sightings within the Scotia mallee (Franklin 1993, Mazzer *et al.* 1998). Sadlier (1994) considered this species to be declining across its range based on the number of recent museum specimens. Although the causes for this decline are unknown, a number of factors are considered to be operating. This includes habitat fragmentation, predation, loss of hollow logs used as sheltering sites the use of baits to control pests (Robertson *et al.* 1989, Sadlier 1994)

Malleefowl were recorded from the Scotia mallee and from the Abbots Tank mallee. These locations are well known sites for Malleefowl (Smith *et al.* 1995, Ayers *et al.* 1996), although only small numbers were observed during this study.

Ayers *et al.* (1996) reported that Major Mitchell's Cockatoo was the most commonly seen threatened species in western New South Wales, a conclusion supported by this study as it was found over a wide area and utilised a range of vegetation communities. Major Mitchell's Cockatoo was recorded less frequently at the Abbots Tank mallee compared to the other mallee sites, possibly because there is little habitat suitable for nesting and the study was conducted during the breeding season. This species requires large, old trees (eg. Belah, White Cypress Pine *Callitris glaucophylla*) with hollows for breeding (Higgins 1999).

The Chestnut Quail-thrush was recorded at each of the three mallee study sites, which supports other survey findings that this species occupies a range of mallee sites (Franklin 1993, Ayers *et al.* 1996, Mazzer *et al.* 1998). Prior to this study, however, observations of Chestnut Quail-thrush to the east of Pooncarie had been limited (Smith *et al.* 1995, Ayers *et al.* 1996).

Ayers *et al.* (1996) reported that Gilbert's Whistlers were previously distributed across the southern mallee region. Franklin (1993) recorded Gilbert's Whistlers as common in the Scotia and Abbots Tank mallee blocks while Mazzer *et al.* (1998) recorded the species occasionally in dunefield mallee west of the Great Anabranch of the Darling River. Mallee to the east of Pooncarie appears to be unsuitable for Gilbert's Whistlers as no birds were recorded there during this study or by Franklin (1993). This study supports Franklin's (1993) findings that the Abbots Tank mallee block is a stronghold for Gilbert's Whistlers.

Shy Heathwren, Southern Scrub-Robin and Red-lored Whistler utilise mallee communities with dense shrubby understoreys, while the Striated Grasswren utilises mallee with a mature understorey of Porcupine Grass *Triodia* spp. (Ayers *et al.* 1996). The mallee sites included in this survey did not contain suitable habitat for these species and were located outside their current known distributions for these species (Ayers *et al.* 1996, NSW NPWS 1999a).

Between 1954 and 1959 the Bush Stone-curlew was considered to be a common species throughout south-western New South Wales, and almost abundant along the Edward River between Deniliquin and Moulamein (Hobbs 1961). Although a number of records of the species has been reported since then (Ayers *et al.* 1996, NSW NPWS 1999b) its status has declined dramatically (P. Maher Consultant pers. comm.). This decline is supported by the current study with only one record being obtained.

No Masked Owls were recorded during the current study. It appears that they are now only infrequent visitors to south-western New South Wales. Historical records include: Gunbar (North 1911), Whitton and Jerilderie (Debus 1993) and Deniliquin (Hobbs 1961). The decline of the Masked Owl in south-western New South Wales has been attributed to the loss of the native small mammal fauna (Debus 1993).

Regent Parrots and Superb Parrots, although not specifically surveyed for during this study, were recorded at a number of sites. Two new breeding colonies of Regent Parrots were located in Euston and Manie State Forests. These areas have since been surveyed by Webster and Leslie (1997) and Webster (1999). Superb Parrots were recorded within their known breeding distribution (Webster 1988).

The Southern Ningaui was recorded from two of the three mallee transects located in the Scotia mallee. This species has been previously recorded within the Scotia mallee to the north of our study site by Ballarat University (J. Miller unpub. data), at Willandra Lakes (Tidemann 1988) and at Yathong Nature Reserve (Dickman and Read 1992). The Southern Ningaui occurs in mallee woodland with a well developed ground cover of Porcupine Grass and shrubs and occasionally in open heath (Kitchener 1995). The transects where the Ningauis were recorded matched this description, but Porcupine Grass was either absent or sparse at the other two mallee study sites. The removal of Porcupine Grass and shrubby ground cover has been demonstrated to result in the disappearance of Ningauis (Dickman and Read 1992). Drought and grazing pressure from domestic stock and feral goats may be responsible for the removal of the ground vegetation at the other two mallee sites and therefore the lack of records.

Suitable habitat for the Kultarr consisting of Acacia shrubland and open plains (Valente 1995) was not surveyed during this study. The Kultarr has not been recorded in southern New South Wales since 1900 (Valente 1995).

There are no recent records of Spotted-tailed Quolls in south-western New South Wales. Records exist near Hay (1970s), from Natya, between Swan Hill and Robinvale in Victoria (1991) and from near Ardlethan (J. Rook Forest Ranger pers. comm. 1990). Most of these records were made during the breeding season and were probably dispersing or displaced males that were either young, old, injured or sick, and may have been displaced from female quoll territories by younger, fitter males (Belcher 2000). As the Spotted-tailed Quoll is a forest dependent species, generally restricted to areas with rainfall greater than 600 mm per year (Mansergh 1984), and no females have been positively recorded from the study area, there is unlikely to be a breeding population of this species in south-western New South Wales. The few records that do exist are likely to be dispersing males originating from the south west slopes of the Great Dividing Range.

The Brush-tailed Phascogale was recorded from two River Red Gum study sites containing box woodland components. The species is considered rare and the only recent record is from Tuppal State Forest (Conole in Ayers *et al.* 1996). The Brush-tailed Phascogale is an obligate hollow user and requires mature trees for denning (Menkhorst 1995). The results of this survey extends the known distribution of the Brush-tailed Phascogale and suggests that the species is rare, but widespread, in south-western New South Wales.

The Squirrel Glider was recorded from River Red Gum forest with a Silver Wattle understorey and from River Red Gum forest/Yellow Box woodland. All the records of Squirrel Gliders from this survey extend its known range in New South Wales (NPWS Atlas of NSW Wildlife 1999) from Mulwala to the west of Moama, reflecting its known distribution in Victoria along the Murray River and habitat requirements (Menkhorst 1995, Quin 1995).

The Koala was recorded in Native Dog State Forest, from a population introduced to Ulupna Island from Phillip and French Islands in 1976 and 1977(Peter Menkhorst DNRE pers. comm.). Koalas have also been recorded from Millewa State Forest in the recent past (1980s) (Forestry Commission of NSW 1985), are known to occur in the Barmah State Forest and Park in Victoria (R. Webster pers. obs.). Koala sightings within Narrandera State Forest are thought to be individuals from the introduced population on the Narrandera Nature Reserve (Parsons 1990). The Koala appears to be rare within the study area despite the suitability of River Red Gum as a food tree. Periodic outbreaks of the Skeletonising Leaf Moth *Uraba lugens* is expected to significantly diminish the habitat value of River Red Gum in some years and may restrict the Koala from increasing its range.

The results of these surveys indicate that State Forests and other Crown timber lands within south-western New South Wales provide important areas of habitat for threatened fauna species. Forestry operations therefore need to consider their habitat requirements. However, as these lands occupy a relatively small proportion of the region, recovery planning processes need to have a landscape focus.

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APPENDIX I

Fauna recorded within the study sites.

Common Name	Scientific Name	Location																																	
		1	2	3	4	5-7	8-9	10	11	12	13-4	15-6	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36-7	38-9	40	Total Sites
Amphibians																																			
Plains Froglet	*Crinia parinsignifera*																				×									×	×				3
Common Eastern Froglet	*Crinia signifera*	×	×	×																	×														4
Eastern Banjo Frog	*Limnodynastes dumerilii*															×																			1
Long-thumbed Frog	*Limnodynastes fletcheri*	×					×								×						×									×	×		×		7
Spotted Marsh Frog	*Limnodynastes tasmaniensis*	×	×	×	×		×	×	×			×	×	×	×	×				×	×									×	×		×		17
Peron's Tree Frog	*Litoria peronii*										×	×			×	×				×	×										×		×		8
Growling Grass Frog	*Litoria raniformis*																×	×			×														3
Reptiles																																			
Eastern Long-necked Tortoise	*Chelodina longicollis*																×												×						2
Marbled Gecko	*Christinus marmoratus*										×																								1
Eastern Spiny-tailed Gecko	*Diplodactylus intermedius*																						×			×									2
Wood Gecko	*Diplodactylus vittatus*																						×			×									2
Tree Dtella	*Gehyra variegata*																×						×			×									3
Beaded Gecko	*Lucasium damaeum*																						×			×									2
	Delma butleri																																		
Burton's Snake-lizard	*Lialis burtonis*																						×												1
Nobbi	*Amphibolurus nobbi*																						×		×	×									3
Mallee Dragon	*Ctenophorus fordi*																						×		×	×									3
Bearded Dragon	*Pogona barbata*										×																			×					2
	Pogona vitticeps																								×										1
Lace Monitor	*Varanus varius*											×				×								×											3
	Crytoblepharus carnabyi															×							×	×									×		4
	Ctenotus atlas																						×												1
	Ctenotus robustus																						×												1
	Ctenotus schomburgkii																									×									1
Desert Skink	*Egernia inornata*																						×												1
	Eulamprus tympannum	×		×	×	×	×					×	×	×																					8
	Lerista muelleri																						×			×									2

APPENDIX I

Common Name	Scientific Name	Location																																
		1	2	3	4	5-7	8-9	10	11	12	13-4	15-6	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36-7	38-9	40	Total Sites
	Lerista punctatovittata																									×									1
	Mentia greyii																									×									1
	Morethia boulengeri																															×	×		2
	Morethia obscura																									×									1
Western Blue-tongued Lizard	*Tiliqua occipitalis*																			×															1
Shingle-back	*Trachydosaurus rugosus*																						×	×	×										3
	Ramphotyphlops australis																						×												1
Carpet Python	*Morelia spilota*																			×															1
Eastern Tiger Snake	*Notechis scutatus*													×																					1
Red-bellied Black Snake	*Pseudechis porphyriacus*					×	×	×			×	×	×																						6
Eastern Brown Snake	*Pseudonaja textilis*																			×									×						2
Birds																																			
Emu	*Dromaius novaehollandiae*										×	×	×				×			×			×		×	×									8
Stubble Quail	*Coturnix pectoralis*															×																			1
Brown Quail	*Coturnix ypsilophora*						×	×																											2
Malleefowl	*Leipoa ocellata*																								×	×									2
Australian Wood Duck	*Chenonetta jubata*	×	×		×	×					×			×	×	×	×	×	×	×					×						×		×		15
Pacific Black Duck	*Anas superciliosa*	×	×	×	×		×									×	×			×				×							×		×		11
Grey Teal	*Anas gracilis*								×							×			×	×	×				×					×	×		×		9
Australasian Grebe	*Tachybaptus novaehollandiae*																								×										1
Darter	*Anhinga melanogaster*																	×		×															2
Little Pied Cormorant	*Phalacrocorax melanoleucos*														×		×	×		×	×														5
Little Black Cormorant	*Phalacrocorax sulcirostris*																					×		×						×					3
Great Cormorant	*Phalacrocorax carbo*											×			×	×	×			×											×		×		7
Australian Pelican	*Pelecanus conspicillatus*								×		×	×			×	×	×		×	×	×	×		×					×		×		×		14
White-faced Heron	*Egretta novaehollandiae*	×	×									×			×	×			×			×											×		8
Great Egret	*Ardea alba*															×																			1
Intermediate Egret	*Ardea intermedia*															×	×			×	×	×									×		×		7
Nankeen Night Heron	*Nycticorax caledonicus*								×								×	×		×													×		5

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Australian White Ibis	*Threskiornis molucca*															×						×							×		3
Straw-necked Ibis	*Threskiornis spinicollis*																			×							×			×	3
Yellow-billed Spoonbill	*Platalea flavipes*		×													×			×			×						×			5
Black Kite	*Milvus migrans*																×			×		×	×								4
Whistling Kite	*Haliastur sphenurus*										×					×	×	×		×	×	×					×		×		9
White-bellied Sea-eagle	*Haliaeetus leucogaster*																											×			1
Brown Goshawk	*Accipiter fasciatus*																									×					1
Collared Sparrowhawk	*Accipiter cirrhocephalus*																×														1
Wedge-tailed Eagle	*Aquila audax*					×							×		×	×				×			×			×		×			8
Little Eagle	*Hieraaetus morphnoides*																			×	×				×						3
Brown Falcon	*Falco berigora*			×											×								×		×	×					5
Australian Hobby	*Falco longipennis*																				×				×						2
Peregrine Falcon	*Falco peregrinus*														×											×					2
Nankeen Kestral	*Falcocenchroides*														×					×			×		×						4
Dusky Moorhen	*Gallinula tenebrosa*																													×	1
Black-tailed Native-hen	*Gallinula ventralis*																			×											1
Painted Button-quail	*Turnix varia*																									×					1
Bush Stone-curlew	*Burhinus grallarius*															×															1
Black-fronted Dotterel	*Elseyornis melanops*																			×		×									2
Masked Lapwing	*Vanellus miles*																		×												1
Caspian Tern	*Sterna caspia*																					×									1
Common Bronze-wing	*Phaps chalcoptera*	×	×	×	×	×		×	×		×	×	×			×	×			×		×	×	×		×				×	18
Crested Pigeon	*Ochyphaps lophotes*														×	×				×		×	×		×			×	×		8
Peaceful Dove	*Geopelia striata*	×	×	×	×	×	×	×	×	×	×	×	×		×	×	×			×	×			×			×	×		×	21
Galah	*Cacatua roseicapilla*	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×		×	×	×			×	×	×	×	×		×	×	25
Long-billed Corella	*Cacatua tenuirostris*						×	×											×										×		4
Little Corella	*Cacatua sanguinea*																×				×	×		×							4
Major Mitchell's Cockatoo	*Cacatua leadbeateri*																						×		×	×					3
Sulphur-crested Cockatoo	*Cacatua galerita*	×	×	×	×	×	×	×	×		×	×	×	×	×	×			×	×	×								×	×	19
Musk Lorikeet	*Glossopsitta concinna*						×																								1
Superb Parrot	*Polytelis swainsonii*																										×	×	×	×	4

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Common Name	Scientific Name	Location																																	
		1	2	3	4	5-7	8-9	10	11	12	13-4	15-6	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36-7	38-9	40	Total Sites
Regent Parrot	*Polytelis anthopeplus*																			×	×														2
Crimson Rosella	*Platycercus elegans flaveolus*	×		×	×	×	×	×	×		×	×	×	×		×	×	×		×	×	×		×					×	×	×		×		22
Eastern Rosella	*Platycercus eximus*											×																					×		2
Australian Ringneck	*Barnardius barnardi*															×	×						×		×	×									5
Blue Bonnet	*Northiella haematogaster*																						×	×											2
Red-rumped Parrot	*Psephotus haematonotus*		×	×	×	×	×		×			×	×		×	×			×	×	×		×	×				x?			×		×		18
Mulga Parrot	*Psephotus varius*																								×	×									2
Pallid Cuckoo	*Cuculus pallidus*										×																						×		2
Horsfield's Bronze-cuckoo	*Chrysococcyx basalis*																				×		×		×	×					×				5
Southern Boobook	*Ninox novaeseelandiae*		×	×	×	×	×	×	×		×	×	×	×	×	×	×			×	×	×							×	×	×		×		21
Barn Owl	*Tytoa alba*						×				×		×		×	×	×			×											×		×		9
Tawny Frogmouth	*Podargus strigoides*	×		×	×	×	×		×		×			×	×	×	×		×	×	×	×							×	×	×		×		19
Spotted Nightjar	*Eurostopodus argus*																						×												1
Australian Owlet-nightjar	*Aegotheles cristatus*					×	×	×							×					×			×		×	×									8
Laughing Kookaburra	*Dacelo novaeguineae*	×	×	×	×	×	×		×	×	×	×	×	×	×	×			×	×		×		×					×		×		×		21
Sacred Kingfisher	*Todiramphus sanctus*	×				×					×			×	×	×	×	×	×	×	×	×		×					×	×	×		×		17
Rainbow Bee-eater	*Merops ornatus*		×	×		×	×	×	×		×	×		×	×	×				×		×	×	×	×	×									17
Dollarbird	*Eurystomus orientalis*																													×			×		2
White-throated Treecreper	*Cormobates leucophaeus*						×		×		×	×		×																					5
Brown Treecreeper	*Climacteris picumuns*	×	×	×	×	×	×	×	×		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×				×	×		×		27
Superb Fairy-wren	*Malurus cyaneus*	×	×	×	×	×	×	×	×	×	×	×	×		×			×		×															15
Splendid Fairy-wren	*Malurus splendens*																								×	×									2
Variegated Fairy-wren	*Malurus lamberti*																			×			×		×	×									4
White-winged Fairy-wren	*Malurus leucopterus*														×					×		×													3
Spotted Pardalote	*Pardalotus punctatus*		×					×	×														×		×	×									6
Striated Pardalote	*Pardalotus striatus*	×	×	×	×	×	×	×	×	×	×	×	×		×	×	×			×	×	×	×	×	×	×			×	×	×		×		26
White-browed Scrubwren	*Sericornis frontalis*	×				×	×																												3
Weebill	*Smicrornis brevirostris*						×		×	×	×	×			×	×				×	×		×		×	×			×	×					14
Western Gerygone	*Gerygone fusca*							×			×	×			×					×	×								×	×	×		×		8

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Chesnut-rumped Thornbill	*Acanthiza uropygialis*															×				×		×	×		×	×					6
Buff-rumped Thornbill	*Acanthiza reguloides*															×															1
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*		×			×	×			×	×	×			×								×								8
Striated Thornbill	*Acanthiza lineata*	×									×	×																			2
Southern Whiteface	*Aphelocephala leucopsis*																			×											1
Red Wattlebird	*Anthochaera carunculata*			×	×	×																			×	×					5
Spiny-cheeked Honeyeater	*Acanthagenys rufogularis*															×						×	×		×	×					5
Striped Honeyeater	*Plectorhyncha lanceolata*																								×				×	×	3
Noisy Friarbird	*Philemon corniculatus*			×		×	×		×		×			×																×	7
Little Friarbird	*Philemon citreogularis*		×		×	×	×		×		×	×		×	×	×	×		×	×	×	×		×			×	×	×	×	20
Blue-faced Honeyeater	*Entomyzon cyanotis*															×	×			×		×					×		×		6
Noisy Miner	*Manorina melanocephala*					×	×						×		×		×	×	×	×	×	×								×	11
Yellow-throated Miner	*Manorina flavigula*																						×	×	×						3
Singing Honeyeater	*Lichenostomus virescens*																						×								1
White-eared Honeyeater	*Lichenostomus leucotis*																						×		×	×					3
Yellow-plumed Honeyeater	*Lichenostomus ornatus*																						×		×	×					3
White-plumed Honeyeater	*Lichenostomus penicillatus*	×	×	×	×	×	×	×	×		×	×	×	×	×	×	×	×	×	×	×	×		×				×	×		23
Black-chinned Honeyeater	*Melithreptus gularis*					×	×	×	×			×	×	×																	7
Brown-headed Honeyeater	*Melithreptus brevirostris*	×						×				×											×		×	×				×	7
White-fronted Honeyeater	*Phylidonyris albifrons*																						×		×	×					3
Black Honeyeater	*Certhionyx niger*																									×					1
Jacky Winter	*Microeca fascinans*			×		×	×	×	×		×	×			×	×							×		×	×			×		13
Red-capped Robin	*Petroica goodenovii*					×			×		×				×					×	×				×	×				×	9
Hooded Robin	*Melanodryas cucullata*							×														×	×			×					4
Grey-crowned Babbler	*Pomatostomus temporalis*										×					×														×	3
White-browed Babbler	*Pomatostomus superciliosus*																			×					×	×					3
Chesnut-crowned Babbler	*Pomatostomus ruficeps*																								×						1
Chesnut Quail-thrush	*Cinclosoma castanotus*																						×		×	×					3
Varied Sittella	*Daphoenositta chrysoptera*																								×	×					2
Crested Shrike-tit	*Falcunculus frontatus*					×	×	×				×	×	×																	6
Crested Bellbird	*Oreoica gutturalis*																						×		×	×					3

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Common Name	Scientific Name	Location																																
		1	2	3	4	5-7	8-9	10	11	12	13-4	15-6	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36-7	38-9	40	Total Sites
Gilbert's Whistler	*Pachycephala inornata*																								×									1	
Rufous Whilster	*Pachycephala rufiventris*	×	×	×	×	×	×	×	×		×	×			×	×			×	×	×		×		×	×			×	×	×				21
Grey Shrike-thrush	*Colluricncla harmonica*	×	×	×	×	×	×	×	×		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×			×	×	×		×		28
Restless Flycatcher	*Myiagra inquieta*		×			×	×				×	×			×	×				×		×	×								×		×		12
Magpie-lark	*Grallina cyanoleuca*	×	×	×	×	×	×	×	×		×	×	×	×	×	×	×	×	×	×	×	×	×							×	×		×		24
Grey Fantail	*Rhipidura fuliginosa*	×	×	×	×	×	×	×		×		×																							9
Willie Wagtail	*Rhipidura leucophrys*	×	×	×	×	×	×		×		×	×	×		×		×	×		×		×	×		×	×			×						19
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	×		×	×	×	×	×			×			×	×	×	×		×	×	×	×	×	×	×	×			×	×	×		×		23
White-bellied Cuckoo-shrike	*Coracina papuensis*								×																										1
Olive-backed Oriole	*Oriolus sagittatus*							×																									×		2
White-breasted Woodswallow	*Artamus leucorhnchus*																							×											1
Masked Woodswallow	*Artamus personatus*																					×				×									2
White-browed Woodswallow	*Artamus superciliosus*																×		×	×	×	×	×	×	×	×									9
Dusky Woodswallow	*Artamus cyanopterus*			×		×	×	×			×	×	×																						7
Grey Butcherbird	*Cracticus torquatus*			×		×											×						×		×	×									6
Pied Butcherbird	*Cracticus nigrogularis*										×	×			×	×				×			×		×	×			×		×		×		11
Grey Currawong	*Strepera versicolor*																						×		×	×									3
Australian Magpie	*Gymnorhina tibicen*	×	×	×	×	×	×	×		×	×	×	×	×	×	×	×	×	×	×		×	×	×	×	×			×		×		×		26
Australian Raven	*Corvus coronoides*	×		×		×	×	×	×		×	×		×	×	×	×	×	×		×	×	×	×	×	×			×	×	×		×		24
Little Raven	*Corvus mellori*										×				×																				2
White-winged Chough	*Corcorax melanorhamphus*	×	×	×	×	×		×	×	×	×		×	×	×	×	×		×	×			×		×	×			×	×	×		×		22
Apostlebird	*Struthidea cinerea*																						×	×									×		3
Red-browed Finch	*Neochima temporalis*					×	×																												2
Diamond Firetail	*Stagonopleura guttata*								×			×																							2
Mistletoebird	*Dicaeum hirundinaceum*			×	×	×	×	×	×	×	×	×	×	×	×	×				×		×	×	×	×	×			×	×	×		×		23
Welcome Swallow	*Hirundo neoxena*	×	×			×	×		×				×		×		×			×															9
Tree Martin	*Hirundo nigricans*			×	×	×	×				×				×		×	×	×	×	×	×	×	×	×				×	×	×				18
Little Grassbird	*Megalurus gramineus*						×																												1
Common Blackbird*	*Turdus merula*																			×															1

APPENDIX I

Common Starling*	*Sturnus vulgaris*																			×		×									×		×		4
Mammals																																			
Short-beaked Echidna	*Tacgyglossus aculeatus*		×	×																			×			×									4
Brush-tailed Phascogale	*Phascogale tapoatafa*	×									×																								2
Yellow-footed Antechinus	*Antechinus flavipes*	×		×		×	×	×	×	×	×	×	×	×						×															12
Southern Ningaui	*Ningaui yvonneae*																								×										1
Common Dunnart	*Sminthopsis murina*																									×		x?	×						3
Sugar Glider	*Petaurus breviceps*					×	×	×			×	×		×																					6
Squirrel Glider	*Petaurus norfolcensis*		×	×	×																														3
Common Ringtail Possum	*Pseudocheirus peregrinus*	×			×	×		×	×			×			×														×	×	×		×		11
Common Brushtail Possum	*Trichosurus vulpecula*	×	×	×	×	×	×	×	×		×	×	×	×	×	×				×		×		×		×		×	×	×			×		22
Eastern Grey Kangaroo	*Macropus giganteus*	×	×	×	×	×	×	×	×		×	×	×		×			×		×						×			×	×			×		18
Western Grey Kangaroo	*Macropus fuliginosus*																×					×	×	×	×										5
Red Kangaroo	*Macropus rufus*																								×	×					×				3
Swamp Wallaby	*Wallabia bicolor*	×					×																												2
Water-rat	*Hydromys chrysogaster*					×						×				×																		×	4
Black Rat*	*Rattus rattus*					×	×	×												×									×			×			6
House Mouse*	*Mus musculus*			×	×	×	×			×	×				×		×	x?		×	×		×		×	×			×		×				16
Dog*	*Cani lupus familaris*	×			×	×	×	×					×			×			×				×	×	×				×	×	×	×		×	16
Fox*	*Vulpes vulpes*	×	×	×	×	×	×					×	×	×	×										×		×		×		×				14
Cat*	*Felius catus*	×	×			×										×															×				5
Rabbit*	*Oryctolagus cuniculus*	×	×	×		×	×			×		×	×		×	×				×			×		×									×	14
Brown Hare*	*Lepus capensis*			×		×				×						×							×												5
Feral Pig*	*Sus scrofa*					×												×																	2
Cow*	*Bos taurus*	×	×	×	×	×					×				×	×										×	×					×	×		12
Sheep*	*Ovis aries*				×		×																×						×			×			5
Goat*	*Capra hircus*																						×		×										2